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A PROPOSAL FOR

TRANSISTOR BANDPASS AMPLIFIERS

AND

THE STUDY AND DEVELOPMENT OF

500 MCS TO 1000 MCS TRANSISTOR AMPLIFIER

P-1150

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Prepared by:

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INTRODUCTION

Section I of this proposal describes a group of five bandpass transistor broadband amplifiers. The frequency range of each type and the quantities requested are:

1.	50 - 90 mcs	5 each
2.	100 - 150 mcs	5 each
3.	50 - 250 mcs	10 each
4.	250 - 500 mcs	10 each
5.	600 - 700 mcs	5 each

Section II of this proposal describes [redacted] capability for the study and development of a 500 mcs to 1000 mcs transistor amplifier. 25X1

All of the above amplifiers will be designed for battery operation and will be made as small as practical.

SECTION I

TECHNICAL PROPOSAL

FOR TRANSISTOR BANDPASS AMPLIFIERS

The transistor preamplifiers will give 11 to 43 db improvement in the present tangential sensitivities. The tangential sensitivities for the 50 - 250 mcs and 250 - 500 mcs receivers are based on 300 uv across 50 ohms. The gain of each proposed amplifier is sufficient to improve the system performance as tabulated below:

1. Amplifier Specifications

Gain	50 db
Bandwidth	50-90 mcs
Noise Figure	9 db
Transistors	4 - 2N700
Input Impedance	50 ohms, noise matched
Output Impedance	50 ohms VSWR < 2
Power Requirements	16 ma @ 12V
Approximate Size	$1\frac{1}{2}$" x 3" x 2"
Quantity Requested	5 each

Present System Specifications		System Specifications with Preamp.	
Band Pass	50-90 mcs		
Video Bandwidth	2 mcs		
Equivalent Bandwidth	14 mcs		
Equivalent Noise Figure	45.5 db	Noise Figure	9 db
Tangential Sensitivity	-50 dbm	Tangential Sensitivity	-83.5 dbm
		Minimum Gain	33.5 db

TANGENTIAL SENSITIVITY
$= -114 + N.F + 10 \log BW$
$-50 = -114 + 45.5 + 18$

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2. Amplifier Specifications

Gain	40 db
Bandwidth	100-150 mcs
Noise Figure	9 db
Transistors	3 - 2N700
Input Impedance	50 ohms, noise matched
Output Impedance	50 ohms VSWR < 2
Power Requirements	16 ma @ 12V
Approximate Size	$1\frac{1}{2}$" x 3" x 2"
Quantity Requested	5 each

Present System Specifications		System Specifications with Preamp.	
Band Pass	100-150 mcs		
Video Bandwidth	2 mcs		
Equivalent Bandwidth	15 mcs		
Equivalent Noise Figure	45.2 db	Noise Figure	9 db
Tangential Sensitivity	-50 dbm	Tangential Sensitivity	-86.4 dbm
		Minimum Gain	36.4 db

3. Amplifier Specifications

Gain	20 db
Bandwidth	50-250 mcs
Noise Figure	9 db
Transistors	3 - 2N700
Input Impedance	50 ohms, noise matched
Output Impedance	50 ohms VSWR < 2
Power Requirements	24 ma @ 12V
Approximate Size	$1\frac{1}{2}$" x 3" x 2"
Quantity Requested	10 each

Present System Specifications		System Specifications with Preamp.	
Band Pass	50-250 mcs		
Video Bandwidth	200 kc		
Equivalent Bandwidth	9 mcs		
Equivalent Noise Figure	14 db	Noise Figure	9 db
Tangential Sensitivity	-77.5 dbm (300 uv @ 50 ohms)	Tangential Sensitivity	-88.5 dbm
		Minimum Gain	31 db

4. Amplifier Specifications

Gain	18 db
Bandwidth	250-500 mcs
Noise Figure	12 db
Transistors	8 - 2N700
Input Impedance	50 ohms, noise matched
Output Impedance	50 ohms VSWR < 2
Power Requirements	32 ma @ 12V
Approximate Size	$1\frac{1}{2}$" x 3" x 2"
Quantity Requested	10 each

Present System Specifications		System Specifications with Preamp.	
Band Pass	250-500 mcs		
Video Bandwidth	200 kc		
Equivalent Bandwidth	10 mcs		
Equivalent Noise Figure	39.5 db	Noise Figure	12 db
Tangential Sensitivity	-57.5 dbm (300 uv @ 50 ohms)	Tangential Sensitivity	-85 dbm
		Minimum Gain	27.5 db

5. Amplifier Specifications

Gain	35 db
Bandwidth	600-700 mcs
Noise Figure	16 db
Transistors	18 - 2N700
Input Impedance	50 ohms, noise matched
Output Impedance	50 ohms VSWR < 2.5
Power Requirements	72 ma @ 12V
Approximate Size	$1\frac{1}{2}$" x 3" x 4"
Quantity Requested	5 each

Present System Specifications		System Specifications with Preamp.	
Band Pass	600-700 mcs		
Video Bandwidth	2 mcs		
Equivalent Bandwidth	20 mcs		
Equivalent Noise Figure	44 db	Noise Figure	16 db
Tangential Sensitivity	-50 dbm	Tangential Sensitivity	-78 dbm
		Minimum Gain	28 db

SECTION II

TECHNICAL PROPOSAL

FOR THE STUDY AND DEVELOPMENT OF

500 MCS TO 1000 MCS TRANSISTOR AMPLIFIERS

The general requirements for the amplifiers to be studied and developed are as follows:

Bandwidth	500 mcs - 1000 mcs
Gain	20 db $\pm$ 2 db
Noise Figure	As low as the transistor state of the art will permit.
Temperature Stability	Equal to vacuum tube amplifiers in the same frequency range.

The objectives of the program will be accomplished in three phases:

The first phase will be a research study and evaluation program to last for a period of four months. This will consist of an accurate evaluation of all available high frequency transistors and a comparison with other presently popular solid state devices. In addition, new techniques for high frequency transistor amplification will be examined.

From the information obtained in Phase I, a design criteria will be established in Phase II. This period will last for three months.

Phase III will consist of a three month construction and evaluation period. Two final models of the 500 mcs to 1000 mcs amplifiers will be delivered ten months from the receipt of contract.

Transistors have given rise to a number of other solid state devices such as tunnel diodes, parametric amplifiers, maser amplifiers, etc., as well as solid state circuits. In addition, much research is being devoted to a more thorough examination of fundamental physical phenomena such as magnetostrictive, thermoelectric, photoelectric and Hall effects.

Most of the more recent publicity has been overwhelming given to the tunnel diode. It has great potentialities as a low noise, low power, high frequency amplifier.

These effects have somewhat removed the interest for high frequency, low noise amplification in the forerunner of the solid state devices; the transistor. The practical frequency limit of the Esaki or tunnel diode is in the neighborhood of 100 kmc. The upper frequency limit for the transistor, particularly the field effect types, is about 50 kmc.

Transistor manufacturers have continually improved fabrication technology to obtain greater frequency limits and low noise figures. The transistor manufacturer's efforts have resulted in higher quality transistors, which, when used in conventional circuitry permits higher frequency amplification. However, a void exists in applying presently available transistors in unconventional circuitry to effectively improve high frequency operation. These techniques, when used with future improved figure-of-merit transistors, will produce even better performance.

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[redacted] has been successful in obtaining broadband amplification from the kcs region to beyond 700 mcs. It is interesting to note that the upper frequency limits are beyond f_T (the frequency at which useful gain is reduced to zero). Presumably the amplification results from a combination of feedback, tunneling, avalanch and other unexplained effects. 25X1

[redacted] know-how for transistorized broadband amplification in the UHF region lends itself well to the utilization of presently available transistors for low noise, high frequency amplification. 25X1